

NRICH LIVE PROBLEMS

Light the Lights again

by Yuto, Joshua, Daichi & Tom

Part 1

of Light the Lights again



We first took photos of all of the numbers, and figured out the patterns. A **yellow** check means the number is odd. A **red** check means the number is multiple of 10. A **blue** check is a number divisible by 3. A **green** check means the number is a square number.

[illegible]

Step 2

It is not possible to make all of the lights light up. An odd number cannot be a multiple of 10, as a multiple of 10 is always even, so the yellow and red lights can't light up together.

[illegible]

Part 2

of Light the Lights again



Step 1

We first took photos of all of the numbers, and figured out the patterns. A **yellow** check means the number is even. A **red** check means the number is multiple of 5. A **blue** check is a number divisible by 4. A **green** check means the number is a multiple of 8.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✗ | X | X | X | X | ✗ | X | X | X | X |
| ✗ | X | X | X | ✗ | X | X | X | ✗ | X |
| ✓ | X | X | X | X | X | X | X | ✓ | X |

| 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✗ | X | X | X | X | ✗ | X | X | X | X |
| ✗ | X | X | X | ✗ | X | X | X | ✗ | X |
| X | X | X | X | ✓ | X | X | X | X | X |

| 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✗ | X | X | X | X | ✗ | X | X | X | X |
| ✗ | X | X | X | ✗ | X | X | X | ✗ | X |
| ✓ | X | X | X | X | X | X | X | ✓ | X |

| 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✗ | X | X | X | X | ✗ | X | X | X | X |
| ✗ | X | X | X | ✗ | X | X | X | ✗ | X |
| X | X | X | X | ✓ | X | X | X | X | X |

| 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✗ | X | X | X | X | ✗ | X | X | X | X |
| X | X | ✗ | X | X | X | ✗ | X | X | X |
| X | X | X | X | X | X | ✓ | X | X | X |

| 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✗ | X | X | X | X | ✗ | X | X | X | X |
| X | X | ✗ | X | X | X | ✗ | X | X | X |
| X | X | ✓ | X | X | X | X | X | X | X |

| 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✗ | X | X | X | X | ✗ | X | X | X | X |
| X | X | ✗ | X | X | X | ✗ | X | X | X |
| X | X | X | X | X | X | ✓ | X | X | X |

| 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✗ | X | X | X | X | ✗ | X | X | X | X |
| X | X | ✗ | X | X | X | ✗ | X | X | X |
| X | X | ✓ | X | X | X | X | X | X | X |

Step 2

It is possible to make all of the lights light up. On 0, all the lights turn on, as 0 is an even number and is a multiple of 5, 4, and 8.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✓ | X | X | X | X | ✓ | X | X | X | X |
| ✓ | X | X | X | ✓ | X | X | X | ✓ | X |
| ✓ | X | X | X | X | X | X | X | ✓ | X |

| 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✓ | X | X | X | X | ✓ | X | X | X | X |
| ✓ | X | X | X | ✓ | X | X | X | ✓ | X |
| X | X | X | X | ✓ | X | X | X | X | X |

| 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✓ | X | X | X | X | ✓ | X | X | X | X |
| ✓ | X | X | X | ✓ | X | X | X | ✓ | X |
| ✓ | X | X | X | X | X | X | X | ✓ | X |

| 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✓ | X | X | X | X | ✓ | X | X | X | X |
| ✓ | X | X | X | ✓ | X | X | X | ✓ | X |
| X | X | X | X | ✓ | X | X | X | X | X |

| 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✓ | X | X | X | X | ✓ | X | X | X | X |
| X | X | ✓ | X | X | X | ✓ | X | X | X |
| X | X | X | X | X | X | ✓ | X | X | X |

| 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✓ | X | X | X | X | ✓ | X | X | X | X |
| X | X | ✓ | X | X | X | ✓ | X | X | X |
| X | X | ✓ | X | X | X | X | X | X | X |

| 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✓ | X | X | X | X | ✓ | X | X | X | X |
| X | X | ✓ | X | X | X | ✓ | X | X | X |
| X | X | X | X | X | X | ✓ | X | X | X |

| 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| ✓ | X | X | X | X | ✓ | X | X | X | X |
| X | X | ✓ | X | X | X | ✓ | X | X | X |
| X | X | ✓ | X | X | X | X | X | X | X |

Part 3

of Light the Lights again



| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|
| | X | X | X | X | | X | X | X | X | | X | X | X | X | | X | X | X | X |
| | X | | X | | X | | X | | X | | X | | X | | X | | X | | X |
| | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | | X |
| X | | X | X | | X | X | X | X | | X | X | X | X | X | X | | X | X | X |

[illegible][illegible]

If there was no limit to how much the number could go, there would be a number that all 4 lights light up. For instance, 900 would make all the lights light up as it is a square number, an even number, a multiple of 5, and a multiple of 9

[illegible]

Part 4

of Light the Lights again



All four lights can't light up at once because there is no number that is both an odd number and an even number at the same time.

| 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 |
|----|----|----|----|----|----|----|----|----|----|
| ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ | X |
| X | X | X | X | ✗ | X | X | X | X | X |
| X | ✓ | X | ✓ | X | ✓ | X | ✓ | X | ✓ |
| X | X | X | ✓ | X | X | X | X | X | X |

[illegible]